



Functional and Radiological evaluation of management of tibial plateau fractures: A prospective study

Priyank Bhatt, Sunil Nikose*

Department of Orthopaedics, Datta Meghe Institute of Medical Sciences, Sawangi (Meghe), Wardha 442001, Maharashtra, India

Article History:

Received on: 18 Sep 2020

Revised on: 18 Oct 2020

Accepted on: 20 Oct 2020

Keywords:

Knee Joint,
Tibial Plateau Fractures,
Open Reduction and
Internal Fixation,
Modified Rasmussen
Score,
WOMAC Score

ABSTRACT

The knee is a crucial joint, as it performs various functions such as standing, walking, running, sitting etc. Tibial plateau fractures constitute 1% of overall fractures and 8% of fractures occurring in the geriatric age group. Knee injuries must be properly and adequately treated to keep the knee in a good functional state. The transition to a fast-paced lifestyle on account of rapid industrialization, urbanization and mechanization has led to a significant increase in the traumatic incidences - especially polytrauma, comminuted Fractures and soft tissue injury. High-speed injury acquired in vehicular accidents and a rise in road traffic injuries together creates a forever increasing issue. The static lower extremity can be encountered by an object in motion, frequent in roadside injury, resulting in the infamous "Bumper Fracture". Open Reduction with Internal Fixation (ORIF) is currently recommended. Hence, a study has been conducted to learn the mode of injury, fracture pattern, outcome of open reduction and internal fixation, complications encountered and associated injuries. 50 Patients were studied prospectively and pre and post-operative evaluation were done using modified Rasmussen clinical and radiological criteria and Womac knee score. Open reduction and internal fixation provide reasonable outcome with regards to functional and radiological outcome in younger patients and type I and II fractures.



*Corresponding Author

Name: Sunil Nikose

Phone:

Email: sunilnikose@gmail.com

ISSN: 0975-7538

DOI: <https://doi.org/10.26452/ijrps.v11iSPL4.4307>

Production and Hosted by

IJRPS | www.ijrps.com

© 2020 | All rights reserved.

INTRODUCTION

The knee joint encompasses the lower end of the femur, upper end tibia & patella. (Putz and Pabst, 2000; Standring, 2008) The transition to a fast-paced lifestyle on account of rapid industrialization,

urbanization and mechanization has led to a significant increase in the traumatic incidences - especially polytrauma, comminuted Fractures and soft tissue injury. One such is the fracture of the tibial plateau. (Whittle, 1998; Yu *et al.*, 2009) Tibial plateau fractures constitute 1% of overall fractures and 8% of fractures occurring in the geriatric age group. (Langford *et al.*, 2006; Barei *et al.*, 2008; Manikandan and Saravanakumar, 2019) One of the most common intraarticular fractures is that of the proximal tibial plateau. (Manikandan and Saravanakumar, 2019; Hohl, 1991) They occur as a result of either indirect trauma that causes a coronary fracture or direct trauma that causes axial compressive patterns. They occur as a result of either indirect trauma that causes a coronary fracture or direct trauma that causes axial compressive patterns. The patterns of fractures are very complex and may involve medial, lateral or both tibial

plateaus. The amount of energy involved during injury determines the intensity of the fracture of the tibial plateau. All fractures have different morphologies and require individual attention. The optimal treatment of fractures of the plateau has long been a topic of debate. They were managed using both non-operative and operative methods. Knee stiffness, mal-union, non-union can complicate conservative treatment at any age. (Koval and Helfet, 1995) Open reduction and internal fixation have been implemented using numerous implants including buttress plate, cancellous screw, external fixator etc., to gain good fracture union and optimal joint function. (Koval and Helfet, 1995; Manikandan and Saravanakumar, 2019) In tibial plateau fractures, treatment goals are anatomical reduction of the articular surface, restoration of axial alignment, and stable fixation to prevent the fracture fragments from being secondarily displaced. This can be achieved very well with the use of open reduction and internal fixation (ORIF), using a plate and screws through different approaches. (Koval and Helfet, 1995; Lavini *et al.*, 2012; Honkonen, 1994) The primary objective of this study is to review the outcome of tibial plateau fracture surgical management in terms of clinical and radiological evaluation using modified Rasmussen criteria (Biyani *et al.*, 1995; Roerdink *et al.*, 2001) and functional evaluation using WOMAC score (Dattani *et al.*, 2013; Roos *et al.*, 1999) at 0, 1, 3 & 6 months.

Patient and Methods

From May 2018 to April 2020, 50 consecutive adult patients with tibial plateau were enrolled. Pre and post-operatively, complete Physical examination of tibial fractures, Clinical & Radiological evaluation specially by using Modified Rasmussen criteria, (Biyani *et al.*, 1995; Roerdink *et al.*, 2001; Dattani *et al.*, 2013) functional evaluation by using Western Ontario And McMaster Osteoarthritis Index (WOMAC) scoring. (Dattani *et al.*, 2013; Roos *et al.*, 1999) All tibial plateau fractures classified by using Joseph Schatzker's classification. Plain radiographs was included anterior-posterior, lateral views. CT scan was used to better demonstrate the extent of plateau depression and comminution than plain radiographs, and which was very helpful in surgical planning.

At the time of followup, clinical features like a surgical scar, range of movements, presence of pain, instability were observed and documented. Various radiological features like callus formation or healing, maintenance of fracture reduction, widening and depression of articular surfaces, varus and valgus collapse, signs of secondary osteoarthritis was

observed and documented. Follow up was taken at 1 month, 3 months & 6 month interval. After discharge, all patients were followed-up regularly in the orthopedic clinic for clinical and radiological assessment. At the final followup at 6 months, all radiographs were reviewed by the senior orthopedic surgeon of the unit for any degree of joint depression, loss of alignment and the presence of OA. Radiological features of OA included the presence of joint space narrowing, articular margin osteophytes, as well as subchondral cysts and sclerosis. Union of at least 3 cortices in AP and Lateral views on followup radiographs was recorded and noted. Any articular step off of 2 mm would be defined as Malreduction. Functional and radiological criteria already mentioned was assessed and evaluated. Data analyzed by using SPSS software version 26.0. Statistical tools used were percentages, mean, Proportion, standard deviation, Chi square Test & Student paired t test and Statistical tests of significance.

RESULTS

It was observed that out of total 50 patients participated in the study maximum i.e.17 (34%) were in the age group of 41-50 years, followed by 11 (22%) in the age group of 31-40 years, 10 (20%) in the age group of 21-30 years, seven (14%) in the age group of 51-60 years, four (8%) in the age group of 61-70 years and one (2%) in the age group of >70 years. There were 42 (84%) were male and eight (16%) were female patient. Figure 1 illustrates age wise distribution of patients.

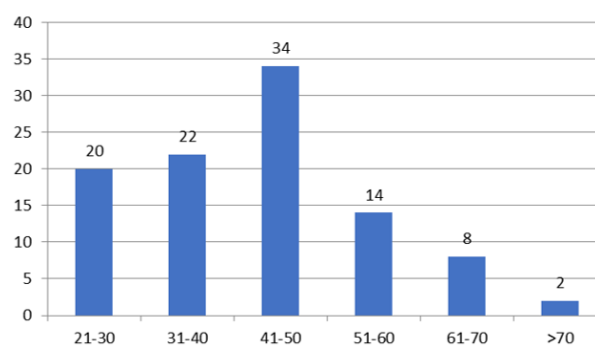


Figure 1: Age Wise Distribution of Patients

Figure 2 illustrates the gender demographics of the study population.

In study 18 (36%) were having Schatzker type V fracture followed by 12 (24%) were having Schatzker type VI fracture, nine (18%) were having type II, six (12%) were having type I, three (6%) were having type IV fracture and two (4%) were having type II fracture. Overall, type II & type V Schatzker fracture account for 54% of the

total injured patients. Amongst these participants 17 (34%) were treated with lateral plate, four (8%) participants treated with medial plate & 29 (58%) were treated with medial plate + lateral plate + CC screw. 11 (22%) underwent bone grafting, while 39 (78%) participants were without bone grafting.

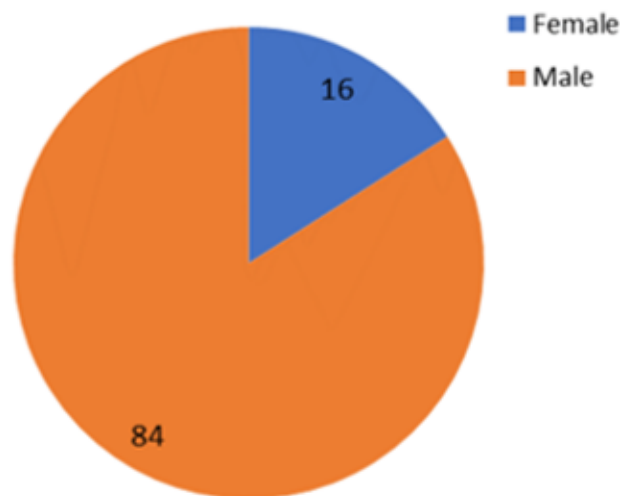


Figure 2: Gender Demographics of the study Population

Figure 3 Illustrates the Schatzker type of fracture distribution.

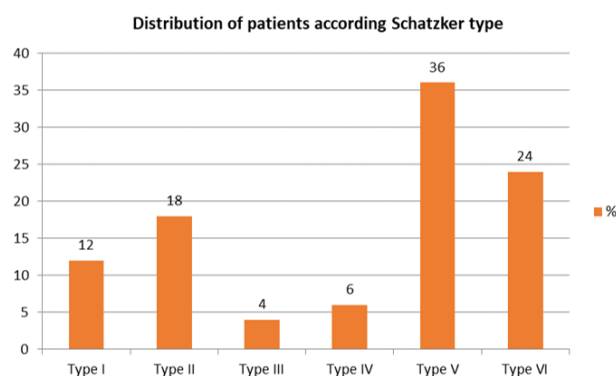


Figure 3: Schatzker type of fracture distribution

Clinical analysis of score during preoperative and post-operative state was poor & difference observed was not statistically significant. However, clinical analysis score was good in 6 study participant, fair in 32 study participant & poor in 12 study participants during 1 month follow up visit. Clinical analysis score was excellent in 4 study participants, good in 35 and fair in 11 study participants during 3 month follow up visit. 6 month follow up visit revealed excellent clinical analysis score in 18 patients, good in 28 patients and fair in 11 study participants. Overall there was improvement in clinical analysis score during 1 month to 6 months follow up visit and the improvement was statistically significant. Table 1 illustrates the clinical score analysis.

Radiological analysis of score was good in 12 study participants, fair in 22 study participants, & poor in 12 study participant during the preoperative period. Radiological analysis score was excellent in 47 study participants, good in 2 and fair in 1 study participants during post operative period with chi square value 89.06 & p value 0.000, which was statistically significant. Radiological analysis score was excellent in 47 study participant, good in 2 & fair in 1 study participant during 1 month follow up visit with chi square value 89.06 & p value 0.000, which was statistically significant. Radiological analysis score was excellent in 47 study participants, good in 2 and fair in 1 study participants during 3 month follow up visit with chi square value 89.06 & p value 0.000, which was statistically significant. 6 month follow up visit revealed excellent radiological analysis score in 46 study participant, good in 3 study participants, and fair in 1 study participants with chi square value 79.07 & p value 0.000 which was statistically significant. Overall there was improvement in radiological analysis score from 1 month to 6 months follow up visit and the improvement was statistically significant. Table 2 illustrates the radiological analysis.

It was observed that out of 50 study participants two (4%) were having implant failure, nine (18%) were reported knee stiffness, three (6%) each reported screw impingement & surgical site maceration, two (4%) participants each reported varus drift & wound dehiscence & 29 (58%) study participants were without any post-operative complications. Table 3 illustrates a complication analysis.

One of the clinical cases with its preoperative and post-operative x ray images and followup X-rays at 1,3 and 6 months is illustrated in Figure 4.

DISCUSSION

Tibial plateau fractures are important fractures in the lower limb. They can be gruelling to manage and pose a considerable challenge to the operating surgeon. Though Schatzker is a simple working classification, Three column classification has been recently used to enhance the accuracy of planning the treatment.

It was observed that out of 50 patients participated in study 42(84%) were male and eight (16%) were female patient. More involvement of males may due to majority of the male population are working and therefore were more prone to roadside accidents while the females in India are mainly engaged in household work, so they are less exposed to vehicular trauma.

Table 1: Clinical Score Analysis

Clinical analysis Score	preoperative	Postoperative	1 month Followup	3 month Followup	6 month Followup
Excellent	0	0	0	4	18
Good	0	0	6	35	28
Fair	0	0	32	11	4
Poor	50	50	12	0	0
Chi square test	-	NA	61.29	100	100
P value	-	-	0.000	0.000	0.000
Significance	-	Not Significant	Significant	Significant	Significant

Table 2: Radiological Analysis

Radiological	Preoperative	postoperative	1 month Followup	3 month Followup	6 month Followup
Excellent	0	47	47	47	46
Good	16	2	2	2	3
Fair	22	1	1	1	1
Poor	12	0	0	0	0
Chi square test	-	89.06	89.06	89.06	79.07
P value	-	0.000	0.000	0.000	0.000
Significance	-	Significant	Significant	Significant	Significant

Table 3: Complication Analysis

Complications	No of patients	%
Implant failure	2	4
Knee stiffness	9	18
Screw impingement	3	6
Surgical site maceration	3	6
Varus drift	2	4
Wound dehiscence	2	4
None	29	58
Grand Total	50	100

A study conducted by the [Haq et al. \(2017\)](#) observed that out of 92 participants, 77(84%) were males and 15(16%) were females. A study conducted by the [Kehribar and Karapinar \(2019\)](#) observed that 29(87.9%) were males and three (12.1%) were females. A study conducted by the [Swarup et al. \(2016\)](#) observed that out of 60 study participant, 78% were males & 22% were females. A study conducted by the [Jakinapally et al. \(2018\)](#) observed that out of 20 study participants, 15 (75%) were males and five (25%) were females. A study conducted by the [Manikandan and Saravanakumar \(2019\)](#) observed that study participants include 70% of males & 30% females. A study conducted by the [Hoffmann et al. \(2012\)](#) observed that out of 129 study participants, 62 (48%) were males

and 67 (52%) were females. A study conducted by the [Sheshagiri et al. \(2016\)](#) observed that out of 20 patients participated in study 17 were males & three were female. A study conducted by the [Zeltser and Leopold \(2013\)](#) observed that out of total patients participated in the study, 70% were male & 30% were female. A study conducted by the [Kayath and Kayathwal \(2019\)](#) observed that majority of the cases were males (84%) while the females were only a small percentage, i.e. 16%. A study conducted by the [Jain et al., \(2019\)](#) observed that males (79.31%) were predominantly involved in the study.

In our study, 17 (34%) participants were treated with lateral plate, four (8%) participants treated with medial plate & 29 (58%) were treated with medial plate+lateral plate+CC screw.



Figure 4: Xray images of a case of tibial plateau managed with open reduction and internal fixation with plate Osteosynthesis

A study conducted by the [Swarup *et al.* \(2016\)](#) observed that Seven patients were managed with cancellous screws; sixteen patients underwent open reduction and fixation with plating while plating supplemented with bone grafting was done in ten patients. Plating with MIPO technique was performed in twelve patients and an external fixator was applied in four patients. Eight patients had fixation done with dual plating. Conducted by the [Jakinapally *et al.* \(2018\)](#) observed that of the 20 cases, three (15%) were managed with percutaneous cancellous screw fixation, seven (35%) cases were treated by Open reduction internal fixation (ORIF) with buttress plate, seven (35%) were treated with ORIF with buttress plate and bone graft, one case (1,5%) managed with ORIF with buttress plating and recon plate, one case (5%) managed with ORIF with buttress plating and cannulated cancellous screw fixation, one case (5%) managed with buttress plate and locking compression plate.

It was observed that 11 (22%) participants undergone bone grafting while 39 (78%) participants were without bone grafting. A study conducted by the [Swarup *et al.* \(2016\)](#) observed that 10 (16.67%) patients undergone bone grafting. Conducted by the [Jakinapally *et al.* \(2018\)](#) observed that seven (35%) patients undergone bone grafting along with ORIF with a buttress plate.

It was observed that out of 50 study participants 16 (32%) patients were having good radiological analysis score, 22 (44%) study participants were having fair radiological analysis score and 12 (24%) were having poor radiological analysis score. A study conducted by the [Kehribar and Karapinar \(2019\)](#) observed that in the radiological findings, nine cases were excellent, 16 were good, six were medium and two were bad.

Total of 50 patients participated in the study were analyzed for the postoperative clinical assessment by the Modified Rasmussen criteria score. It was observed that all 50 patients participated in the study were having poor clinical analysis score. A study conducted by the [Kehribar and Karapinar \(2019\)](#) observed that as per the clinical findings, 17 cases were excellent, nine were good, six were medium and one was poor.

All the patients participated in the study undergone 6 months follow up visit for clinical assessment by Modified Rasmussen criteria. It was observed that 18 (36%) patients were having excellent clinical analysis score, 28 (56%) were having good clinical analysis score and four (8%) were having fair clinical analysis score. A study conducted by the [Jain *et al.* \(2019\)](#) observed that mean Modified Rasmussen score was poor in 10.34%, fair in

12.07, good in 58.62% and excellent in 18.97% of the patients at 6 months of follow up visit.

A study conducted by the [Swarup et al. \(2016\)](#) observed that out of 60 study participants final end result as per Rasmussen's criteria was excellent in 37, good in 11, fair in six and poor in six patients. A study conducted by the [Jakinapally et al. \(2018\)](#) observed that nine (45%), cases had excellent outcome, seven (35%) cases had a good outcome, three (15%) cases had fair outcome and one (5%) case had a poor outcome. A study conducted by the [Zakei et al. \(2018\)](#) observed that end results was excellent in 59.3%, good in 37%, and fair in 3.7% of patients participated in the study. A study conducted by the [Jain et al. \(2016\)](#) observed that twenty-two patients showed excellent results while eight patients had good to fair and none with poor result.

All the patients participated in the study undergone 6 months follow up visit for radiological assessment by Modified Rasmussen criteria. It was observed that 46 (92%) patients were having excellent radiological analysis score, three (6%) were having good radiological analysis score and one (2%) were having fair radiological analysis score. The radiological outcomes were determined by Modified Rasmussen assessment in the study conducted by the [Manikandan and Saravanakumar \(2019\)](#) & observed that scores were graded as Excellent in 55%, Good in 40%, Fair in 5% and Poor in 0% of patients. A study conducted by the [Sheshagiri et al. \(2016\)](#) observed that radiological outcome was excellent in 15 (75%) patients followed by the good outcome in 20% patients and the fair outcome was achieved in just one patient and none of the patients had a poor outcome. All the study participants were assessed clinically by Modified Rasmussen criteria during preoperative, postoperative, 1 month followup, 3 month follow up and 6 month follow up visit.

It was observed that clinical analysis of score of all 50 patients during preoperative and postoperative state was poor & difference observed was not statistically significant. Clinical analysis score was good in six study participants, fair in 32 study participant & poor in 12 study participants during 1month follow up visit. Clinical analysis score was excellent in four study participants, good in 35 and fair in 11 study participants during 3 month follow up visit. 6 month follow up visit revealed excellent clinical analysis score in 18 patients, good in 28 patients and fair in 11 study participants. Overall there was improvement in clinical analysis score during 1 month to 6 months follow up visit and the improvement was statistically significant. A study conducted

by the [Zakei et al. \(2018\)](#) observed a highly significant difference between results after 1, 3, and 6 months. A study conducted by the [Kayath and Kayathwal \(2019\)](#) observed that out of 50 cases treated with surgical procedure, 30 cases gave the excellent result, 16 cases came out with a good result, fair in three cases and only one case had a poor result Rasmussen functional score.

CONCLUSIONS

Tibial plateau fractures were observed to be more common among males, in 41-50 years of age group with Road traffic accident being the most common cause. Majority of the fractures were of comminuted type and Type V and Type VI fractures (Schatzker's classification). Statistically, significant improvement was observed while assessing clinical outcome by Modified Rasmussen criteria at 1 month, 3 month & 6 month followup compared to preoperative & post-operative condition of patients. Statistically, significant improvement was observed while assessing radiological outcome by Modified Rasmussen criteria during the postoperative period, at 1 month, 3 month & 6 months followup compared to the preoperative condition of patients. The functional outcome was favorable in younger age group & type I & type II fractures. Stiffness of knee joint, screw impingement & surgical site maceration were some of the complications observed and therefore, careful attention has to be given to overcome these complications.

ACKNOWLEDGEMENT

Department of Orthopaedics, Datta Meghe Institute of Medical Sciences, Wardha.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

Funding Support

The authors declare that they have no funding support for this study.

REFERENCES

- Barei, D. P., et al. 2008. Frequency and Fracture Morphology of the Posteromedial Fragment in Bicondylar Tibial Plateau Fracture Patterns. *Journal of Orthopaedic Trauma*, 22(3):176-182.
- Biyani, A., et al. 1995. The results of surgical management of displaced tibial plateau fractures in the elderly. *Injury*, 26(5):291-297.
- Dattani, R., et al. 2013. Psychometric anal-

- ysis of measuring functional outcomes in tibial plateau fractures using the Short Form 36 (SF-36), Short Musculoskeletal Function Assessment (SMFA) and the Western Ontario McMaster Osteoarthritis (WOMAC) questionnaires. *Injury*, 44(6):825-829.
- Haq, S. N. U., et al. 2017. To Evaluate Results of Operative Management of Tibial Plateau Fractures. *Journal of Liaquat University of Medical & Health Sciences*, 16(03):135-138.
- Hoffmann, M. F., et al. 2012. Outcome of periprosthetic distal femoral fractures following knee arthroplasty. *Injury*, 43(7):1084-1089.
- Hohl, M. 1991. Part I. Fractures of the proximal tibia and fibula. *Fractures in adults*, 3:1725-1761.
- Honkonen, S. E. 1994. Indications for Surgical Treatment of Tibial Condyle Fractures. *Clinical Orthopaedics and Related Research*, 302:199-205.
- Jain, R., et al. 2016. Prospective Case Study of Outcome of Tibial Plateau Fractures Treated with Locking Condylar Plate. *Malaysian Orthopaedic Journal*, 10(3):12-16.
- Jain, R. K., et al. 2019. Study of management of distal 1/3rd tibial shaft fracture by intramedullary nailing. *National Journal of Clinical Orthopaedics*, 3(4):29-35.
- Jakinapally, S. R., et al. 2018. Functional and radiological evaluation of surgical management in tibial plateau fractures: a prospective study. *International Journal of Research in Orthopaedics*, 4(2):261-265.
- Kayath, A. M., Kayathwal, A. K. 2019. Prospective study to measure the functional outcome of tibial plateau fractures. *International Journal of Research in Orthopaedics*, 5(6):1061-1064.
- Kehribar, L., Karapinar, L. 2019. Comparison of surgical treatment results and clinical and radiological findings of tibial plateau fractures. *Sanamed*, 14(2):147-147.
- Koval, K. J., Helfet, D. L. 1995. Tibial Plateau Fractures: Evaluation and Treatment. *Journal of the American Academy of Orthopaedic Surgeons*, 3(2):86-94.
- Langford, J. R., et al. 2006. Tibial Plateau Fractures. *Musculoskeletal Key Fastest Musculoskeletal Insight Engine*, pages 1133-1146.
- Lavini, F., et al. 2012. Tibial plateau fractures: compared outcomes between ARIF and ORIF. *Strategies in Trauma and Limb Reconstruction*, 7(3):163-175.
- Manikandan, N., Saravanakumar, K. P. 2019. A study on functional and radiological outcome of complex tibial plateau fractures by posteromedial plating. *International Journal of Research in Orthopaedics*, 5(2):223-226.
- Putz, R., Pabst, R. 2000. Sobotta Atlas of Human Anatomy (V. 2). page 400. Lippincott Williams and Wilkins.
- Roerdink, W. H., et al. 2001. Arthroscopically assisted osteosynthesis of tibial plateau fractures in patients older than 55 years. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*, 17(8):826-831.
- Roos, E. M., et al. 1999. WOMAC Osteoarthritis Index: Reliability, validity, and responsiveness in patients with arthroscopically assessed osteoarthritis. *Scandinavian Journal of Rheumatology*, 28(4):210-215.
- Sheshagiri, V., et al. 2016. Functional and radiological outcome of tibial plateau fractures (schatzker type 5 & 6) treated with ilizarov circular external ring fixator. *Journal of Evidence Based Medicine and Healthcare*, 3(1):30-35.
- Standring, S. 2008. The Anatomical Basis of Clinical Practice, Expert Consult - Online and Print. page 1576. Gray's Anatomy.
- Swarup, A., et al. 2016. Functional outcome of surgical management of tibial plateau fractures in adults. *International Journal of Research in Medical Sciences*, 4(3):908-912.
- Whittle, A. P. 1998. Fractures of lower extremity. page 4664. Campbell's operative orthopaedics.
- Yu, Z., et al. 2009. Functional and radiological evaluations of high-energy tibial plateau fractures treated with doublebuttress plate fixation. *European Journal of Medical Research*, 14(5):200.
- Zakei, A. M., et al. 2018. Evaluation of operative results of displaced tibial plateau fractures. *Menoufia Medical Journal*, 31(1):311.
- Zeltser, D. W., Leopold, S. S. 2013. Classifications in Brief: Schatzker Classification of Tibial Plateau Fractures. *Clinical Orthopaedics & Related Research*, 471(2):371-374.